SUBSECTION 8.15

Geologic Hazards and Resources

8.15 Geologic Hazards and Resources

8.15.1 Introduction

This Geologic Resources and Hazards section evaluates the effect of geologic hazards and resources that might be encountered on the project site and associated linear facilities. The objective of this analysis is to evaluate potential project impacts resulting from construction or operation of the project. This section presents a summary of the relevant LORS, the project setting, environmental impacts, and proposed mitigation measures affecting geological resources. In addition, permits that are required and permitting agencies are identified.

8.15.2 Laws, Ordinances, Regulations, and Standards

The LORS that apply to geologic resources and hazards are summarized in Table 8.15-1.

TABLE 8.15-1
Laws, Ordinances, Regulations, and Standards

Jurisdiction	Authority	Administering Agency	Compliance
State/Local	Uniform Building Code (UBC), 1997. Appendix Chapter 16, Division 4	City of San Joaquin Planning Division	Acceptable design criteria for structures with respect to seismic design and load-bearing capacity
State/Local	California Building Code (CBC), 1998	Fresno County Planning Division	Acceptable design criteria for structures with respect to seismic design and load-bearing capacity
State/Local	City of San Joaquin General Plan	City of San Joaquin	Compliance with Chapter 8 of the safety element of the General Plan

8.15.3 Affected Environment

The proposed CVEC site is an 85-acre parcel (zoned for industrial use) in the City of San Joaquin, Fresno County, California. The project site and linears are located within the Great Valley-geomorphic province that is characterized as an area of low alluvial plains and fans (Croft and Gordon, 1968). The Great Valley is a 400-mile-long, northwest-southeast trending structural basin that extends along the center of the state from the Klamath Range in the north to the Tehachapi Mountains in the south. The region around the site is a geologic "bowl" filled with alluvium derived from the Coast Ranges to the west and the Sierra Nevada to the east. The proposed generating facility site is relatively flat (approximate elevation 145 feet) and is underlain by Quaternary alluvial deposits. Although the mountainous areas to the east and west are seismically active, the Central Valley is considered to be seismically stable.

8.15.3.1 Regional Geology

The geology of the CVEC vicinity and linears is not complex. The Central Valley is a structural trough overlying bedrock formations between the Coast Ranges and the Sierra Nevada. This "trough" has been filled with marine, lacustrine, and alluvial deposits of Cretaceous, Tertiary and Quaternary

age. Deposits up to 30,000 feet are present near the western edge of the valley and dip relatively uniformly from each side of the valley towards its axis.

8.15.3.2 Local Geology

The local geology is composed of basin deposits of recent quaternary age underlain by continental deposits. Figure 8.15-1 shows the geology within a 2-mile radius of the CVEC site. The stratigraphy and structure of the local area are discussed below.

8.15.3.2.1 Stratigraphy

Several rock types are present beneath the CVEC site and linears. These are discussed below and are based on descriptions from the Geologic Map of California, Santa Cruz and Fresno Sheets (Jennings and Strand, 1958; Matthews and Burnett, 1965) and California Geology (Norris and Webb, 1990). A generalized geologic stratigraphic column beneath the project site is described in Table 8.15-2 and shown on Figure 8.15-2.

TABLE 8.15-2
Description of Stratigraphy for Project Site and Linears

Stratigraphy	Description
Quaternary Basin Deposits	These consist of unconsolidated silt, clay, and fine sand deposits from alluvial and fan systems. Thickness ranges from about 100 to 200 feet.
Quaternary Older Alluvium	These consist of unconsolidated silt, clay, sand, and gravel from alluvial and lacustrine depositional systems. These may contain both oxidized and reduced areas. This layer is approximately 700 feet thick.
Tertiary Lacustrine and Marsh Deposits	Silts, clays, and fine sands. Often gypsiferous, fosilliferous, and reduced. Interfingers with younger alluvial and older marine deposits. This layer is approximately 2,000 feet thick.
Tertiary Continental Deposits	Consists of unconsolidated, fine-to medium-grained sand, silt, clay, and some gravel deposits. Together with the marine deposits, compose a stratigraphic thickness of approximately 6,000 feet.
Cretaceous Marine Deposits	Contains consolidated sandstone, siltstone, and shale deposits.
Pre-Tertiary Basement deposits	Contains metamorphic and igneous rocks and lies approximately 8,000 feet below ground surface.

8.15.3.2.2 Structure

The basement complex, which consists of metamorphic and igneous rocks, slopes steeply westward from the Sierra Nevada under the younger rocks that compose the valley fill. A major cycle of crustal deformation occurred during the Mesozoic and Tertiary times (65-225 million years ago) which included the progressive uplift of the Sierra Nevada and Coast Ranges and the downwarping of the area that is the Central Valley.

The project site and water line are located in a flat area, no significant topographic or geologic structure exists in the vicinity of these project components.

The gas line is also on relatively flat topography, but its terminus is at a higher elevation (approximately 580 feet mean sea level). The subsurface geologic structure along the western side of the Central Valley is comprised of the same geologic units as the central part of the valley, but is encountered at a much shallower depth.

8.15.3.3 Regional Seismicity

Although seismic activity occurs to the east in the Sierra Nevada and to the west in the Coast Ranges, the Central Valley of California is considered to be seismically stable (City of San Joaquin, 1996; Fresno County, 2000). The site and related linear facilities do not lie in an Alquist-Priolo Earthquake Zone (Fresno County, 1997).

The most recent significant seismic activity that has occurred in the site vicinity was the 1983 Coalinga Earthquake. A Richter Magnitude (M) of 6.7 was measured. This earthquake is believed to be associated with the Coast Range-Sierran Block blind fault zone at depth; there are no apparent surface features or ground ruptures indicating the presence of this fault (Mualchin, 1996). An aftershock (M5.2) of this earthquake was accompanied by surface rupture along the Nuñez Fault.

8.15.3.3.1 Major Faults

Two faults are present within 30 miles of the site. These are the Coast Range-Sierran Block blind thrust fault that is located approximately 20 miles southwest of the site and the Nuñez Fault, which is approximately 25 miles to the west (Mualchin, 1996). Faults in the site vicinity are shown on Figure 8.15-3.

Other faults in the vicinity of the site include: the San Andreas Fault, which lies approximately 50 miles to the southwest; the Owens Valley Fault, which is approximately 100 miles to the east; and the Ortigalita Fault, approximately 35 miles northeast of the site. An inferred fault, the Clovis Fault, is approximately 40 miles to the east.

The Division of Mines and Geology has identified the project site area to be within Seismic Zone 6. This corresponds to the UBC designation of Seismic Zone 3 (Fresno County, 2000). The western end of the gas linear terminates in Seismic Zone 4 (Fresno County, 2000).

None of the linear facilities cross any known fault. However, the western terminus of the gas pipeline linear approaches the mapped location of the Coast Range-Sierran Block blind thrust fault. This is a deep-seated, implied fault, and no surface expression exists.

8.15.3.4 Geologic Hazards

The following subsections discuss the potential geologic hazards that might occur in the project area based on a literature search. Additional information would be available following review from a site-specific geotechnical report, which will be completed in the fourth quarter of 2001 and provided to CEC.

8.15.3.4.1 Surface Fault Rupture

No faults were found to cross either the CVEC site or any of the linear facility corridors (Fresno County, 1997).

8.15.3.4.2 Seismic Shaking

The most significant geologic hazard at the CVEC site is strong ground shaking due to an earthquake. Mualchin (1996) estimated that the ground shaking of an M8 earthquake along the San Andreas Fault could produce peak ground gravity (g) acceleration of up to 0.2g in the vicinity of the CVEC. The gas linear, on its western end, approaches the Coast Range-Sierran Block blind thrust zone. This thrust zone may experience ground activity up to 0.6g (Mualchin, 1996).

8.15.3.4.3 Liquefaction

During strong ground shaking, loose, saturated, cohesionless soils can experience a temporary loss of shear strength. This phenomenon is known as liquefaction. Liquefaction of soils is dependent on grain size distribution, relative density of the soils, degree of saturation, and intensity and duration of the earthquake. The potential hazard associated with liquefaction is seismically induced settlement.

Although the depth to groundwater may be shallow (less than 30 feet), the likelihood that liquefaction would occur is low because the soil types typically present are generally too coarse (sands and gravels) or too high in clay content to be conducive to liquefaction (Fresno County, 1997). No information is currently available to determine the site-specific potential liquefaction hazards.

8.15.3.4.4 Slope Stability

Slope instability depends on steepness of the slope, underlying geology, surface soil strength, and moisture in the soil. Significant excavating, grading, or fill work during construction might introduce slope stability hazards at either the CVEC site or along linear facility routes. Because the CVEC site itself is flat and no significant vertical excavation is planned during site construction, the potential for direct impact from landslides at the site is considered nonexistent.

8.15.3.4.5 Subsidence

Subsidence can be caused by natural phenomena during tectonic movement, consolidation, hydrocompaction, or rapid sedimentation. Subsidence can also result from human activities, such as withdrawal of water and/or hydrocarbons in the subsurface soils. Significant regional subsidence has been experienced in the vicinity of the City of San Joaquin. This subsidence has resulted from long-term withdrawal of groundwater causing compaction of fine-grained sediments in the aquifer system. The United States Geological Survey has mapped a subsidence of approximately 4 to 8 feet in the project site area (USGS, 2001). Approximately 15 miles to the northwest (near Mendota, California) subsidence of up to 28 feet has been mapped. It is not known what the yearly rate of subsidence at the project site may be, as it will vary greatly due to the rate of regional groundwater withdrawal.

8.15.3.4.6 Expansive Soils

Expansive soils shrink and swell with wetting and drying. The shrink-swell capacity of expansive soils can result in differential movement beneath foundations. Expansive soils have been mapped along the Fresno Slough area and are likely to be present under both the linear facilities and the CVEC site (Fresno County, 1997).

8.15.3.4.7 Geologic Resources of Recreational, Commercial, or Scientific Value

Geologic resources of recreational, commercial, or scientific value in the project vicinity that could be affected comprise sand and gravel mines and oil and gas reserves. Geologic resources of value were identified and evaluated by reviewing maps presented in the Fresno County General Plan (Fresno County, 1997). The geologic resources are discussed below because of their economic value and proximity to the project site.

8.15.3.4.8 Sand, Gravel, and Mineral Resources

There are several sand, gravel, and mineral resources in the County, primarily along the western and eastern borders (Fresno County, 1997). No significant mineral resources are currently mined within 20 miles of the site (Fresno County, 1997). No Mineral Resource Zones (MRZs), as defined by the California Department of Conservation, the area of the project site or linears. According to Open File Report 99-02 (Young, 1999), MRZs exist within 1 mile of the linear facilities but will not be impacted by the project.

8.15.3.4.9 Oil and Gas

Oil production occurs throughout the County; two oil fields are located within 10 miles of the site (Fresno County, 1997). One of the fields is located approximately 5 miles to the east, and the other is located approximately 6 miles to the south.

There are no known geologic resources that provide a significant scientific value in the vicinity of the site.

8.15.4 Environmental Impacts

8.15.4.1 Generating Facility

8.15.4.1.1 Geologic Hazards

Ground shaking presents the most significant geologic hazard to the proposed CVEC generating facility and linear facilities. Regional subsidence has occurred at the site in the past, due to removal of groundwater, which could affect the project. The potential for high shrink-swell in soils beneath the CVEC site and linear facilities may also affect the project. Mitigation measures proposed in Section 8.15.3 should be implemented in the design of the facilities to reduce risk associated with these hazards. Table 8.15-3 summarizes the geologic hazards associated with the CVEC site and linear facilities.

TABLE 8.15-3
Summary of Potential Geologic Hazards

Project Component	Area of Potential Concern	Geologic Hazards of Potential Concern
Proposed Generating Facility Site	Entire site (up to 85 acres)	Seismic ground shaking; subsidence; shrink-swell
Electric Transmission Line	Entire route	Seismic ground shaking; subsidence; shrink-swell
Offsite Natural Gas Pipelines	Entire route	Seismic ground shaking; subsidence; shrink-swell
Water and Other Pipelines	Entire route	Seismic ground shaking; subsidence; shrink-swell

8.15.4.1.2 Geologic Conditions and Topography

Construction will require minor grading and excavation, thereby altering the terrain of the CVEC site and linear facilities. Impacts to the geologic conditions involve dust generation, changes in drainage, cuts, and fills. Since the site is generally level, site grading is not expected to adversely impact the geologic environment.

8.15.4.2 Linear Facilities

Linear facilities associated with the CVEC site include electricity transmission, natural gas, water, and reclaimed water lines discussed below. The geologic hazards associated with the linear facilities are summarized in Table 8.15-3.

8.15.4.2.1 Electric Transmission Line

Seismically induced ground shaking, subsidence, and possible high shrink-swell potential could affect the stability of the transmission lines. These possible hazards along the route could affect the stability of the transmission lines. With implementation of the mitigation measures proposed in Section 8.15.5, the hazards will be reduced to acceptable levels.

8.15.4.2.2 Natural Gas Supply Line

Seismically induced ground shaking, subsidence, and possible high shrink-swell potential could affect the stability of the natural gas supply lines. These possible hazards may be present along the proposed transmission line route, and could affect the stability of the supply lines. With implementation of the mitigation measures proposed in Section 8.15.5, the hazards will be reduced to acceptable levels.

8.15.4.2.3 Water and Other Lines

Seismically induced ground shaking, subsidence, and possible high shrink-swell potential could affect the stability of the water and other lines. These possible hazards present along the proposed water and

other line route could affect the stability of the lines. With implementation of the mitigation measures proposed in Section 8.15.5, the hazards will be reduced to acceptable levels.

8.15.4.3 Geologic Resources of Recreational, Commercial, and Scientific Value

The project site is relatively flat and is primarily composed of recent alluvial sediments of little recreational value. Sand, gravel and mineral deposits are one of the resources of Fresno County but are not present in the vicinity of the project site. Oil and gas production also occurs in the County. Construction and operation of the CVEC site would not affect these resources. Also, there are no known geologic resources that provide a significant scientific value in the vicinity of the site. Therefore, the CVEC project would not affect these resources.

8.15.5 Mitigation Measures

The following subsections describe mitigation measures that could be used to reduce impacts from geologic hazards.

8.15.5.1 Surface Faulting Rupture

No active faults were noted to cross the CVEC site or any of the linear facility corridors (Jennings and Strand, 1958; Mualchin, 1996). Therefore, no mitigation measure is required to reduce the hazard from surface faulting rupture.

8.15.5.2 Ground Shaking

The CVEC generating facility and water linear facilities will need to be designed and constructed to withstand strong earthquake shaking as specified in the 1997 UBC for Seismic Zone 3 – in accordance with City of San Joaquin and County of Fresno requirements. The gas linear will need to be constructed to Seismic Zone 4 specifications.

8.15.5.3 Liquefaction

No site-specific soils information is available. A liquefaction analysis must be prepared as part of the geotechnical investigation that will be completed prior to construction.

8.15.5.4 Subsidence

Subsidence has occurred regionally at the project site. A site-specific soils engineering report required by the County will specify the actual degree of subsidence and any mitigation that will be required.

8.15.5.5 Expansive Soils

Expansive soils are likely present under both the linear facilities and the CVEC site. Expansive soils can be mitigated by either removing the soil and back-filling with non-expansive soil, instituting a chemical stabilization of the soil, or by constructing a foundation treatment that resists uplift of the expansive soil. Site-specific conditions will be evaluated during facility planning/construction to determine the most appropriate mitigation measure that may be required.

8.15.6 Involved Agencies and Agency Contacts

There are no specific state or local agencies having specific jurisdiction over geologic resources. However, in accordance with the safety element of both the City of San Joaquin and Fresno County, the respective planning departments are responsible for ensuring compliance with building standards.

8.15.7 Permits Required and Permit Schedule

Compliance of building construction to UBC standards is covered under engineering and construction permits for the project. No other permit requirement that specifically addresses geologic resources and hazards is identified.

8.15.8 References

City of San Joaquin. 1996. Safety Element of the City of San Joaquin General Plan. January.

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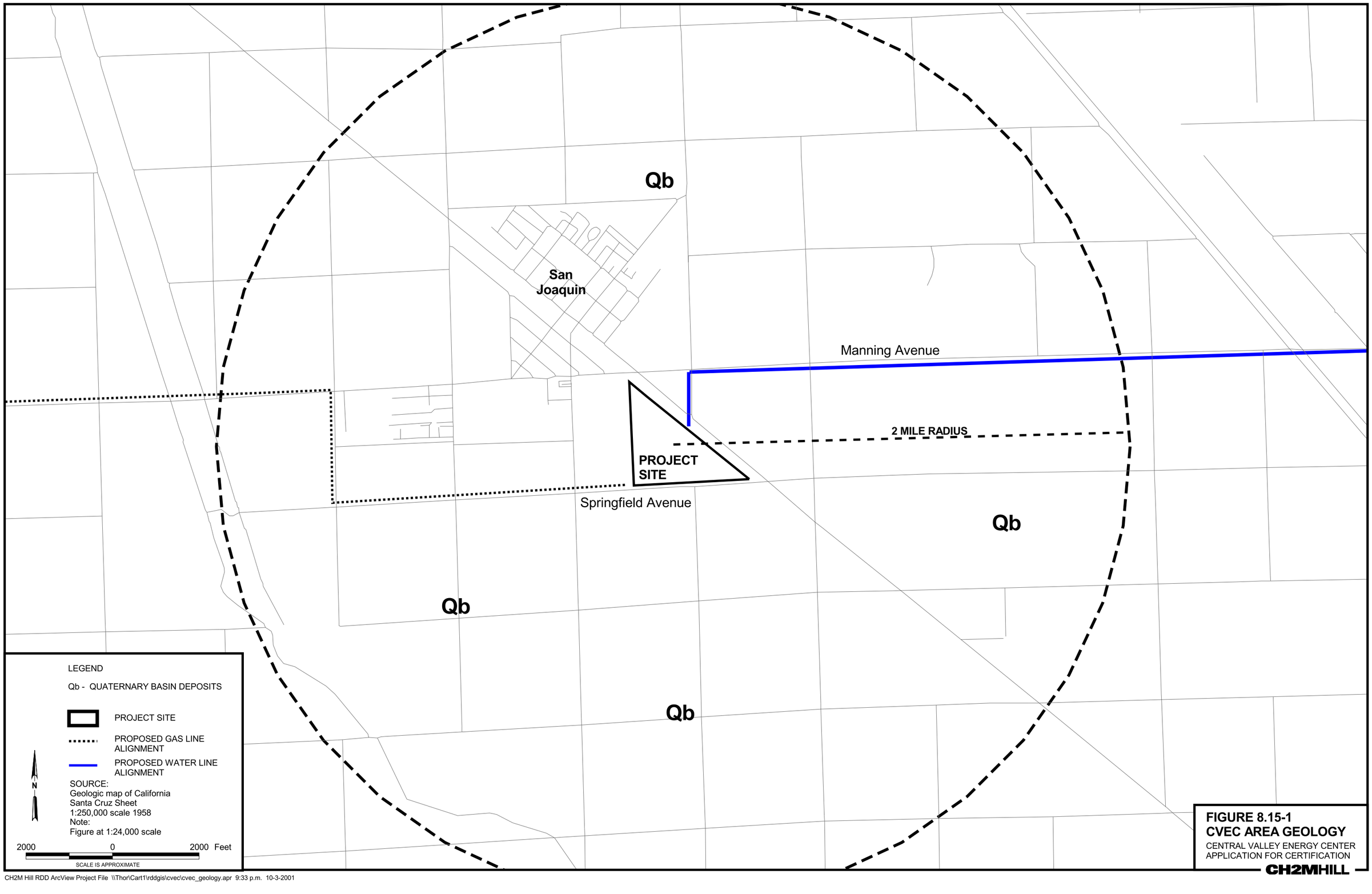

FIGURE 8.15-1
CVEC AREA GEOLOGY
CENTRAL VALLEY ENERGY CENTER
APPLICATION FOR CERTIFICATION
CH2MHILL

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System	Geologic Unit	Lithologic Character	Maximum Thickness (feet)
Recent	Basin Deposits	Silts, clays and fine sands. Reduced. Fossiliferous.	200
Recent and Pleistocene	Older Alluvium	Sands, fine to coarse gravels, silts, and clays. Well sorted. Moderately oxidized. Contains well-developed soil profiles and hardpan horizons in oxidized zones. Unweathered in reduced zones.	700
Tertiary	Lacustrine and Marsh Deposits	Silts, clays, and fine sands. Fossiliferous. Gypsiferours. Reduced.	2000
	Continental Deposits	Fine to medium grained sands, silts, clays and some gravels. Contains both weathered and oxidized zones.	600
Cretaceous	Marine	Consolidated sandstone, siltstone and shale deposits.	10,000+
Pre-Tertiary	Basement	Metamorphic and Igneous rocks	— —

Source: Norris and Webb, 1990 and Jennings, 1958

FIGURE 8.15-2
CVEC GENERALIZED STRATIGRAPHY AT PROJECT SITE
CENTRAL VALLEY ENERGY CENTER APPLICATION FOR CERTIFICATION

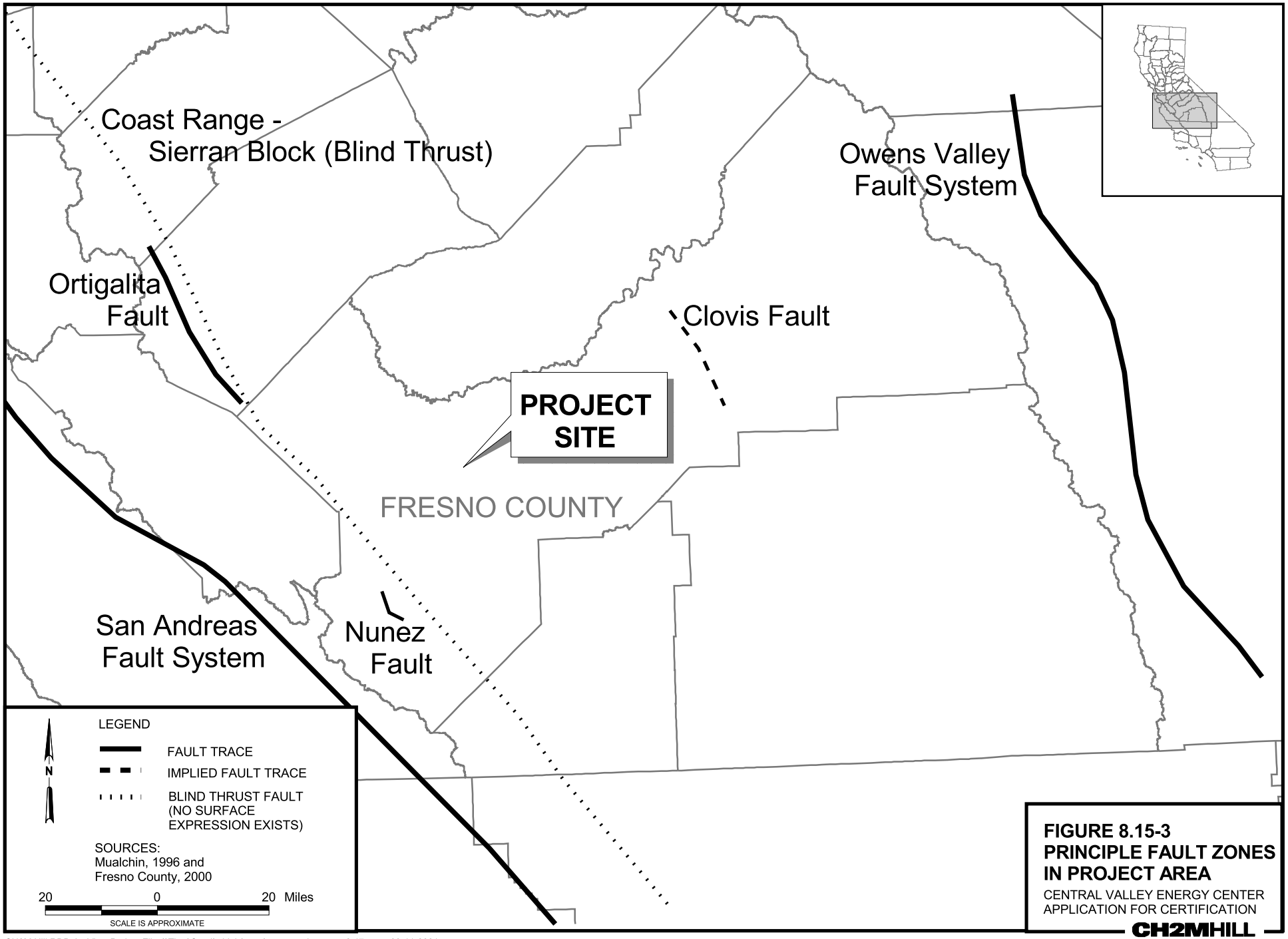

FIGURE 8.15-3
PRINCIPLE FAULT ZONES IN PROJECT AREA
CENTRAL VALLEY ENERGY CENTER
APPLICATION FOR CERTIFICATION

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